CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A data recorder comprising:

an angular rate sensor producing an angular rate sensor output;

a processor coupled to the angular rate sensor; and

a memory coupled to the processor for storing the angular rate sensor output.

2. The data recorder of claim 1 further comprising a comparing means for comparing the angular rate sensor output with an angular rate threshold.

3. The data recorder of claim 2 further comprising storing means for storing the angular rate sensor output in the memory if the angular rate sensor output is greater than the angular rate threshold.

4. The data recorder of claim 2 where the processor is configured to store the angular rate sensor output in the memory if the angular rate sensor output is greater than the angular rate threshold.

5. The data recorder of claim 4 further comprising continuous sampling means for continuously sampling the angular rate sensor output.

6. The data recorder of claim 4 where the processor is configured to continuously sample the angular rate sensor output.

7. The data recorder of claim 6 further comprising an angular rate filter coupled between the angular rate sensor and the processor for allowing only angular rate sensor outputs within a frequency range to reach the processor.

8. The data recorder of claim 7 further comprising a gain circuit for amplifying the angular rate sensor output.

9. The data recorder of claim 8 further comprising an analog-to-digital converter coupled to the angular rate sensor output for converting the angular rate sensor output to a digital value.

10. The data recorder of claim 9 further comprising a linear accelerometer producing a linear accelerometer output.

11. The data recorder of claim 10 further comprising a comparator for comparing the linear accelerometer output with a linear acceleration threshold.

12. The data recorder of claim 11 where the processor is configured to store the linear accelerometer output in the memory if the linear accelerometer output exceeds the linear acceleration threshold.

13. The data recorder of claim 12 including a humidity sensor, the humidity sensor producing a humidity sensor output, and the processor is configured to store the humidity sensor output in memory.

14. The data recorder of claim 13 including a temperature sensor, the temperature sensor producing a temperature sensor output, and the processor is configured to store the temperature sensor output in memory.

15. The data recorder of claim 14 including a data communication interface.

16. The data recorder of claim 15 where the processor is configured to receive information from the data communication interface and the processor is configured to transmit information through the data communication interface.

17. A data recorder comprising:

a first linear accelerometer producing a first linear accelerometer output;

a first angular rate sensor producing a first angular rate sensor output;

a memory;

and a processor coupled to the first linear accelerometer, the first angular rate sensor and the memory, the processor configured to store the first linear accelerometer output and the first angular rate sensor output in the memory.

18. The data recorder of claim 17 further comprising a first linear accelerometer filter for allowing first linear accelerometer outputs within a frequency range to reach the processor.

19. The data recorder of claim 18 further comprising a first angular rate sensor filter for allowing only first angular rate sensor outputs within a select frequency range to reach the processor.

20. The data recorder of claim 19 further comprising a first angular rate sensor gain circuit coupled to the first angular rate sensor output for amplifying the first angular rate sensor output and a first linear accelerometer gain circuit coupled to the first linear accelerometer output for amplifying the first linear accelerometer output.

21. A data recorder comprising:

an X-axis linear accelerometer producing an X-axis linear accelerometer output;

a Y-axis linear accelerometer producing a Y-axis linear accelerometer output;

a Z-axis linear accelerometer producing a Z-axis linear accelerometer output;

a roll angular rate sensor producing a roll angular rate sensor output;

a pitch angular rate sensor producing a pitch angular rate sensor output;

a yaw angular rate sensor producing a yaw angular rate sensor output;

a memory; and

a processor configured to continuously monitor the X-axis linear accelerometer, the Y-axis linear accelerometer, the Z-axis linear accelerometer, the roll angular rate sensor, the pitch angular rate sensor and the yaw angular rate sensor and to store in the memory the X-axis linear accelerometer output, the Y-axis linear accelerometer output, the Z-axis linear accelerometer output, the roll angular rate sensor output, the pitch angular rate sensor output if the pitch angular rate sensor and the yaw angular rate sensor output if the X-axis linear accelerometer, the Y-axis linear accelerometer, the Z-axis linear accelerometer, the roll angular rate sensor, the pitch angular rate sensor or the yaw angular rate sensor exceed a pre-determined threshold.

25. The data recorder of claim 24 where the processor is configured to store in the memory a time stamp.

26. The data recorder of claim 25 where an X-axis filter is coupled to the X-axis linear accelerometer, a Y-axis filter is coupled to the Y-axis linear accelerometer, a Z-axis filter is coupled to the Z-axis linear accelerometer, a roll filter is coupled to the roll angular rate sensor, a pitch filter is coupled to the pitch angular rate sensor, and a yaw filter is coupled to the yaw angular rate sensor.

27. The data recorder of claim 26 where an X-axis gain circuit is coupled to the X-axis filter, a Y-axis gain circuit is coupled to the Y-axis filter, a Z-axis gain circuit is coupled to the Z-axis filter, a roll gain circuit is connected to the roll filter, a pitch gain circuit is connected to the pitch filter, and a yaw gain circuit is connected to the yaw filter.

28. A method of operating a self-contained data recorder, the self-contained data recorder having a housing, an angular rate sensor with an angular rate sensor output, a processor, a memory, and a power supply comprising the steps of:

continuously sampling the angular rate sensor output;

comparing the angular rate sensor output with a threshold;

and, if the angular rate sensor output is greater than the threshold, storing a plurality of angular rate sensor outputs in the memory.

29. The method of claim 28 further comprising the step of storing a plurality of angular sensor date stamps with the plurality of angular rate sensor outputs.

30. The method of claim 29 further comprising the step of ceasing the storing of the plurality of angular rate sensor outputs in the memory if the angular rate sensor output falls below the threshold.

31. The method of claim 30 further comprising the step of ceasing the storing of the plurality of angular rate sensor outputs in the memory if the storing of the plurality of angular rate sensor outputs exceeds a first time limit.

32. The method of claim 31 further comprising the step of prohibiting the storing of a plurality of angular rate sensor outputs for a first period of time when the storing of the plurality of angular rate sensor outputs exceeds the first time limit.

33. The method of claim 32 where the self-contained data recorder has a linear accelerometer, the linear accelerometer having a linear accelerometer output, further comprising the steps of:

continuously sampling a linear accelerometer output;

comparing the linear accelerometer output with a threshold; and if the linear accelerometer output is greater than the threshold, storing a plurality of linear accelerometer outputs in the memory.

34. The method of claim 33 further comprising the step of ceasing the storing of the plurality of linear acceleration outputs series in the memory if the linear acceleration output falls below the linear accelerometer threshold.

35. The method of claim 34 further comprising the step of ceasing the storing of the plurality of linear accelerometer outputs in the memory if the storing of the plurality of linear accelerometer outputs exceeds a second time limit.

36. The method of claim 35 further comprising the step of the step of prohibiting the storing of the plurality of linear accelerometer outputs for a second period of time if the storing of the plurality of linear accelerometer outputs exceeds the second time limit.

37. The method of claim 36 further comprising the step of recalibrating the linear accelerometer after ceasing the storing of the plurality of the linear acceleration outputs.

38. A data recorder comprising:

a housing;

a first linear accelerometer contained within the housing and producing a first linear accelerometer output;

a second linear accelerometer contained within the housing and producing a second linear accelerometer output;

a third linear accelerometer contained within the housing and producing a third linear accelerometer output;

a first angular rate sensor contained within the housing and producing a first angular rate sensor output;

a second angular rate sensor contained within the housing and producing a second angular rate sensor output;

a third angular rate sensor contained within the housing and producing a third angular rate sensor output;

a memory contained within the housing;

a processor contained within the housing and configured to store in the memory either the first linear accelerometer output, second linear accelerometer output, third linear accelerometer output, first angular rate sensor output, second angular rate sensor output, or third angular rate sensor output;

and a power supply contained with the housing.

39. The data recorder of claim 38 where the first angular rate sensor measures a first angular rate about a first angular rate sensor axis, the second angular rate sensor measures a second angular rate about a second angular rate sensor axis, and the third angular rate sensor measures a third angular rate about a third angular rate sensor axis, and the first angular rate sensor axis, the second angular rate sensor axis and the third angular rate sensor axis are substantially orthogonal.

40. The data recorder of claim 39 where the first linear accelerometer measures a first linear acceleration along a first linear acceleration axis, the second linear accelerometer measures a second linear acceleration along a second linear acceleration axis and the third linear accelerometer measures a third linear acceleration along a third linear acceleration axis, and where the first linear acceleration axis, the second linear acceleration axis and the third linear acceleration axis are substantially orthogonal.

41. The data recorder of claim 40 where the first linear acceleration axis and the first angular rate sensor axis are substantially collinear, the second linear acceleration axis and the

second angular rate sensor axis are substantially collinear, and the third linear acceleration axis and the third angular rate sensor axis are substantially collinear.

42. The data recorder of claim 41 further including a clock for generating a time stamp.

43. The data recorder of claim 42 where the processor is configured to store the time stamp in the memory when the processor stores in the memory the first linear accelerometer output, the second linear accelerometer output, the third linear accelerometer output, the first angular rate sensor output, the second angular rate sensor output, or the third angular rate sensor output.

44. The data recorder of claim 43 where the processor is configured to store the first linear accelerometer output, the second linear accelerometer output, the third linear accelerometer output, the first angular rate sensor output, the second angular rate sensor output, or the third angular rate sensor output only when the first linear accelerometer output, the second linear accelerometer output, the third linear accelerometer output, the first angular rate sensor output, the second angular rate sensor output, or the third angular rate sensor output exceed a threshold.

45. The data recorder of claim 44 where the processor is configured to continuously store the first linear accelerometer output, the second linear accelerometer output, the third linear accelerometer output, the first angular rate sensor output, the second angular rate sensor output, or the third angular rate sensor output only when the first linear accelerometer output, the second linear accelerometer output, the third linear accelerometer output, the first angular rate sensor output, the second angular rate sensor output, or the third angular rate sensor output exceeds the threshold.

46. The data recorder of claim 45 where the processor is configured not to store the first linear accelerometer output, the second linear accelerometer output, the third linear accelerometer output, the first angular rate sensor output, the second angular rate sensor output, or the third angular rate sensor output does not exceeds the threshold.

47. The data recorder of claim 46 where the processor is configured to stop storing the first linear accelerometer output, the second linear accelerometer output, the third linear accelerometer output, the first angular rate sensor output, the second angular rate sensor output, or the third angular rate sensor output after a select period of time.

48. The data recorder of claim 47 where the processor is configured to calculate a velocity change from the first linear accelerometer output, the second linear accelerometer output and the third linear accelerometer output.

49. The data recorder of claim 48 where the processor is configured to determine a peak linear acceleration from the first linear accelerometer output, the second linear accelerometer output and the third linear accelerometer output.

50. The data recorder of claim 49 further comprising a humidity sensor producing a humidity sensor output and a temperature sensor producing a temperature sensor output, where the humidity sensor and the temperature sensor are contained within the housing and where the processor is configured to store the humidity sensor output and the temperature sensor output.

51. The data recorder of claim 50 further comprising a communication interface contained substantially within the housing allowing for communication of the data recorder with external devices.

52. The data recorder of claim 51 where the communication interface includes a wireless communication device.

53. A data recorder comprising:

a housing;

a first angular rate sensor contained within the housing and producing a first angular rate sensor output;

a memory for storing the first angular rate sensor output; and

a power supply contained within the housing.

54. The data recorder of claim 53 further comprising a second angular rate sensor contained within the housing and producing a second angular rate sensor output and where the memory stores the second angular rate sensor output.

55. The data recorder of claim 54 further comprising a third angular rate sensor contained within the housing and producing a third angular rate sensor output and where the memory stores the third angular rate sensor output.

56. The data recorder of claim 55 further comprising a processor contained within the housing for performing a process with the first angular rate sensor output, the second angular rate sensor output and the third angular rate sensor output.

57. The data recorder of claim 56 further comprising a communication interface contained within the housing and, in response to a command, will download the first angular rate sensor output, the second angular rate sensor output and the third angular rate sensor output stored in memory to a device external to the housing.

58. The data recorder of claim 57 where the communication interface includes a wireless communication device.

59. The data recorder of claim 58 further comprising an analog-to-digital converter contained within the housing for digitizing the first angular rate sensor output, the second angular rate sensor output and the third angular rate sensor output.